Swedish Transport System for Spent Nuclear Fuel

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Introduction

Swedish transport system consists of one purpose-built vessel, five terminal vehicles, ten transport casks and monitoring system in order to transport spent nuclear fuel from nuclear power plants to Central Interim Storage Facility (CLAB) in storage pools blasted out of the rock. Since all nuclear power plants are located by the sea and also have harbors for large tonnage, ocean-based Swedish transport system is simple and natural. Swedish nuclear fuel and waste management company (SKB) is responsible for the disposal of nuclear waste and spent nuclear waste, and has a overall task including transport planning, execution of transport, development and maintenance of the transport system. The transport system has fulfilled the requirements stipulated by Swedish regulations[1,2,3,4] on transport of dangerous goods based on IAEA *Safety Standards Series No.TS-R-1[5] and IMO International Maritime Dangerous Goods Code[6]*. Swedish Nuclear Power Inspectrate (SKI) reviews and monitors the transport. SKB, nuclear power plants and transport related co-companies gather twice a year and make an optimized semiannual and yearly transport planning and then report to SKI.

Purpose-Built Vessel

The purpose-built vessel named as m/s Sigyn, which is shown in Fig.1, was especially constructed for shipments of spent nuclear fuel and radioactive waste. It is a combined roll-on/roll-off vessel with an reinforced hull for breaking ice. The design of the vessel with double hull, double bottom, double propulsion and safety systems is intended to prevent an accident that leads to damage to the cargo with the risk of injurious effect on personnel or surroundings. The cargo hold is separated from the machine room and the crew quarters by radiation shielded walls. The transport casks are transported and positioned in the cargo hold with the aid of the terminal vehicle. Ten positions with permanent devices in the cargo hold for lashing down are intended for heavy items such as transport casks and vehicles. The dimensions of the vessel are 4,166tons of gross tonnage, 2,044tons of dead weight, 90m of overall length, 18m of greatest width, and 4m of draft. And the service speed is 11.8knots.

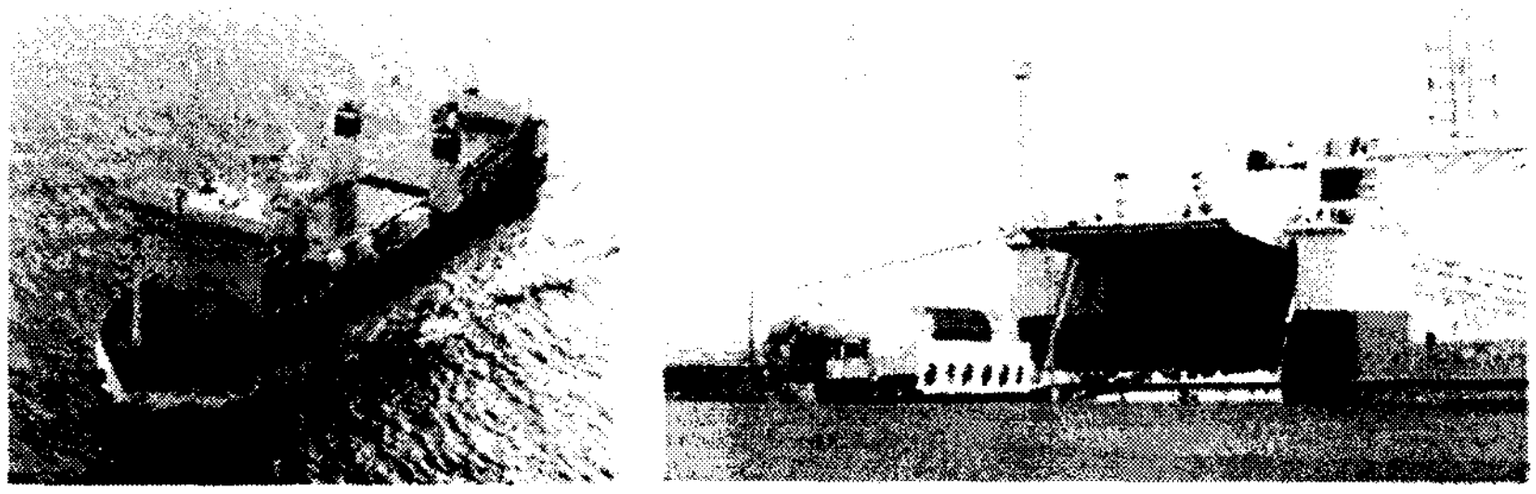

Fig.1 Purpose-built vessel

Transport Vehicle

All land shipments of transport casks in nuclear power plant sites are carried out with the aid of five terminal vehicles, which is presented in Fig.2. The vehicles are especially constructed to carry heavy loads,

and their platforms can be raised and lowered hydraulically. When handling transport casks the vehicle drives in the hold of the vessel and lifts it hydraulically to the correct height. The vehicle drives on-board and puts the casks in place. Every vehicle is provided with a radio system for communication with the escort car, monitoring center and control room. It is also equipped with a radio-controlled brake system. If the vehicle is subject to an emergency stop, it cannot be restarted without measures taken by the monitoring center. The fuel and electrical systems are separated from each other as far as possible for reasons of fire protection and the vehicles are equipped with fire extinguishing equipment. Radiation shielded wall is installed in accordance with Swedish requirement not to exceed of 0.01mSv/h in driver's cabin.

Transport Cask

Transport cask as shown in Fig.3 is to protect the surroundings from the ionizing radiation that spent nuclear fuel emits and at the same time to allow for heat dispersal due to the fuel's residual heat that must be cooled down. The cask also has the task of protecting the spent nuclear fuel from damage during shipment. The design of the cask is suited to fulfill the requirements of IAEA regulations. The cask is made of a tube-shaped forged steel with welded bottom that is lined on the inside and outside with welded-on stainless steel. Copper fins are welded to the cladding for heat dispersal. The cask is lifted with an overhead crane by means of shanks mounted in pairs. The cask is sealed with a double lid system.

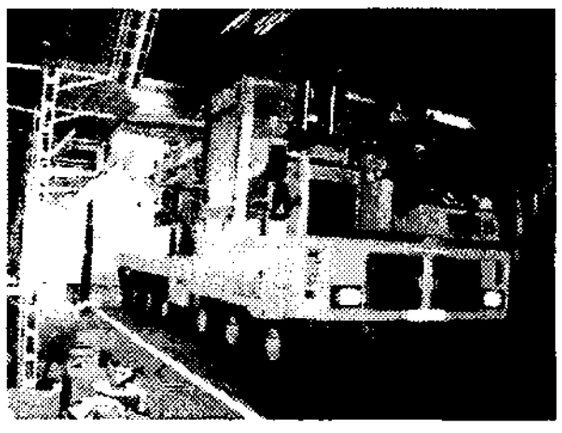

Fig.2 Transport vehicle

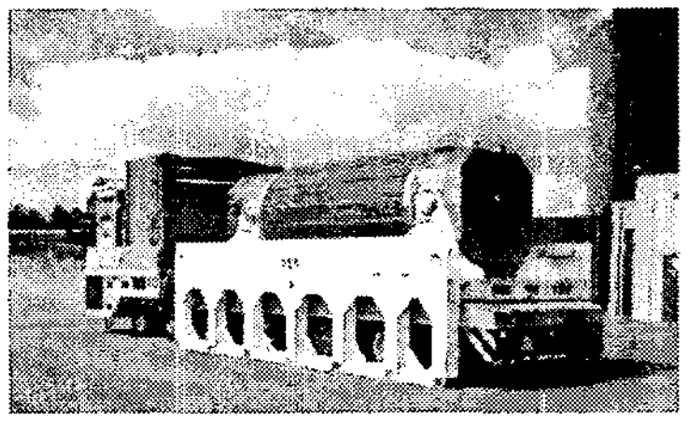

Fig.3 Transport cask

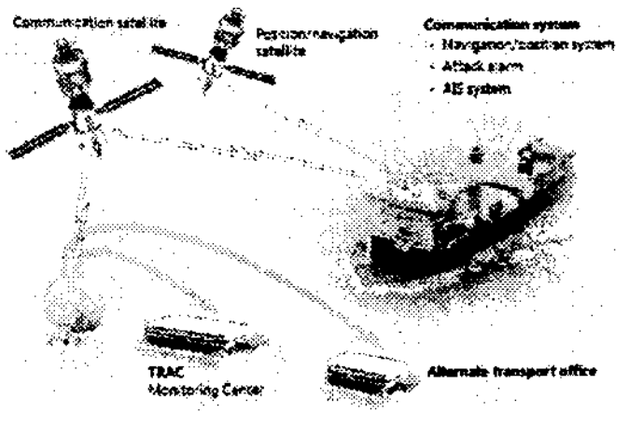

Fig.4 Monitoring system

Monitoring System

Monitoring system for sea transport presented in Fig.4 satisfies partly the requirements for physical protection required for transport of spent nuclear fuel, and partly the requirement of SKB and its operation organizations with regard to communication and follow-up during current transports. Transports are supervised by the monitoring center (TRAC). The vessel and TRAC have several independent communication systems for making contact, determining the position of the vessel. If a reason for elevated preparedness exists, TRAC must be able to take measures, for instance, call in supervisory personnel or police. It is important that TRAC has real-time information regarding transports currently underway.

REFERENCES

[1] The Swedish Act (2006:263) on carriage of dangerous goods, 2006.

[2] The Swedish Maritime Administration's regulations(SJOFS 1985:24), 1985.

[3] The Swedish Maritime Administration's general recommendations on fire protection on ships and SJOFS (2004:31), 2004.

[4] The Swedish Rescue Service Agency's regulation (SRVFS 2006:7), 2006.

[5] IAEA Safety Standards Series No.TS-R-1, Regulation for safe Transport of Radioactive material, 2005.

[6] IMO International Maritime Dangerous Goods(IMDG) Code, 1997.